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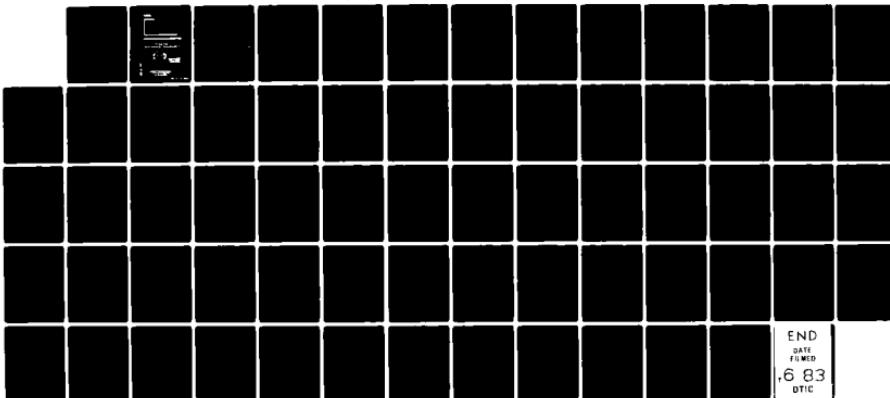
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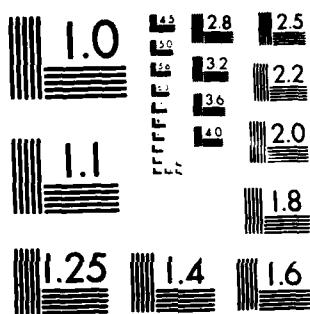
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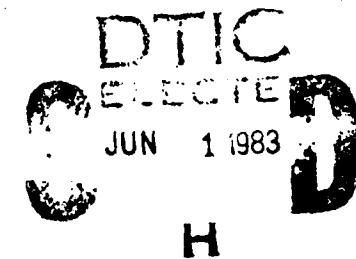
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PERSONNEL TURNOVER COST AND MANAGEMENT
IN NAVAL OPERATIONS

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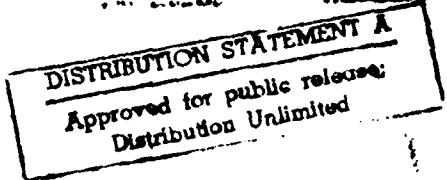
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INTRODUCTION

This study involves the development and application of a model for measuring the Personnel Replacement Cost of Industrial Engineers at two sites, the Seal Beach Naval Weapons Station and the North Island Naval Air Rework Facility.

The research demonstrates the potential utility of using replacement cost information in making policy decisions in the area of human resource management in the Navy. It is a step towards linking human resource decision making with the "coin of the realm." In particular, the relevance of replacement cost data to decision making involving issues such as training personnel internally versus the hiring of more experienced, outside personnel is demonstrated.

Specific Objectives

This research had four basic objectives:

1. To review selected available data and systems for collecting information which is relevant to measuring and monitoring turnover and replacement cost of Navy personnel.
2. To develop models for measuring the cost of turnover of selected positions in the Navy.
3. To conduct a pilot study of the feasibility and measurement problems involved in deriving the cost of turnover for selected personnel classification.
4. To analyze the data derived from the pilot study in order to assess potential implications for human resource management policies in the Navy as well as possible areas for future research.

Need for Replacement Cost Information

Recently, there has been increasing appreciation of the importance and value of human resources to an organization. "Human capital" (consisting of the knowledge, skills and experience which employees possess and acquire) has come to be considered an important organizational "asset".

In our developing post-industrial age, information technologies requiring highly skilled human services are becoming central to organizational activities. Paradoxically, however, it is common for organizations to have an "informational gap", lacking the information necessary to support vital decision making in the human resources area.

The "human asset" represented by a skilled employee is often costly to acquire and develop. Individuals may join organizations only after costly recruiting and selection procedures have been undertaken. Furthermore, the training reflected in the development of experienced personnel can typically represent a organization cost of an even higher order of magnitude. This training can be provided either by the hiring organization itself or essentially "purchased" by obtaining more experienced personnel from the outside at a higher starting salary.

In either case, considerable investment is made in the recruitment, selection and training of people. Consequently, employee turnover

can result in substantial organizational cost. The replacement cost incurred to effectively select and train new people after the termination of an employee is frequently not known by management.

Human resource replacement cost data can supply management with information necessary for optimal decision making in the human resources area. Of course, there are many qualitative factors essential to human resource planning and decision making. It is through the interaction of these factors with economic information such as replacement cost that more adequate decision can be made.

Thus replacement cost information provides appropriate analytical information for management decision support and yet allows for thorough consideration of non-quantifiable factors.

Research Sites

Two research sites were used in this study: 1) the Seal Beach Naval Weapons Station and 2) the North Island Naval Air Rework Facility.

Seal Beach Location: This site is a naval weapons station, located in Seal Beach, California. The positions under study are located in the Industrial Engineering Division, which serves as a consultant and advisor to all departments on the application of industrial engineering and productivity principles and techniques. The division administers programs which provide evaluation, development and implementation of methods, equipment and facilities. Its

objective is to provide services which will upgrade capabilities and enhance productivity while enabling employees to work in an environment that does not contribute to environmental pollution.

The position under study (for which replacement cost data was obtained) is Supervisory Industrial Engineer (GS-12). This position has responsibility for administrative direction, technical control and decision authority for operation of one of the branches of the Industrial Engineering Division. A detailed position description is presented in Appendix A.

North Island Location: This site is a naval air rework facility, a tenant activity of the Naval Air Station, located in Coronado, California. The positions under study at this location are in the Facilities Management Branch of the Facilities Engineering Division. The Facilities Management Branch provides engineering services pertaining to the justification, design, construction, utilization and maintenance of command facilities.

The position under study at North Island is also the Supervisory Industrial Engineer (GS-12). This position has responsibility for providing multi-discipline engineering service pertaining to all aspects of the utilization of covered building space and real property assets; for preparing detailed engineering studies to enhance productivity to modifications to existing shop arrangements; for supervising industrial engineers and industrial engineering technicians; and for exercising all personnel administration responsibilities. A detailed position description is presented in Appendix A.

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RESEARCH METHODOLOGY

This research plan for this project consists of seven steps, as shown in Table 1 and discussed next:

TABLE 1
SUMMARY OF RESEARCH PLAN STEPS

<u>Step No.</u>	<u>Description</u>
1.0	Orientation to Navmat Operations and selection of positions targeted for replacement cost analysis.
2.0	Develop descriptions of sequences of steps involved in personnel processes of recruitment, selection and training.
3.0	Identify cost items (classifications) associated with processes of recruitment, selection and training.
4.0	Develop models for measuring replacement cost for selected Navy positions.
5.0	Design data collection approach and instruments for measuring replacement cost on a pilot basis and implement.
6.0	Calculate replacement cost for selected positions.
7.0	Analyze cost data for human resource management implications and assess possible areas for future research.

Orientation to NAVMAT Operations

A meeting was held in the office of the Deputy Chief of NAVMAT in order to orient the researchers to NAVMAT operations. The Productivity Advisor to the Deputy Chief was also present. As a result of this meeting a specific target position for this research was identified (GS-12 Supervisory Industrial Engineers) and specific sites in Southern California were identified for collection of replacement cost data.

Subsequent to this meeting, orientation visits were made to the designated research sites, the Seal Beach Naval Weapons Station and the North Island Air Rework Facility. Preliminary interviews were conducted with the Head of the Industrial Engineering Department at Seal Beach and with Branch Head of the Facilities Management Branch at North Island.

These preliminary interviews were designed to explain the nature of the research project, obtain further information about the target position and to begin to gather data about recruitment, selection and training practices.

Description of Recruitment, Selection and Training Steps

The next step was to develop standardized descriptions of the steps involved in recruitment, selection and training of GS-12 Supervisory

Industrial Engineers at Seal Beach and at North Island. Since the GS-12 Supervisory Industrial Engineer is not typically an entry level position, it was necessary to ascertain "normative" career paths for this position at each research site. Training components for each position in the career ladder were then detailed.

These normative career paths were charted with the help of the Branch Heads of each Industrial Engineering area under study. Interviews were also conducted with incumbent GS-12 Supervisory Industrial Engineers in order to obtain historical confirmation that the career paths charted had validity.

The steps involved in recruitment, selection and training were obtained by interviews with the Branch Heads of each area, with selected GS-12's supervising the selection and training of employees recruited for positions leading up to the targeted positions, and with designated representatives of the Personnel or Industrial Relations Departments.

Identification of Recruitment, Selection and Training Costs

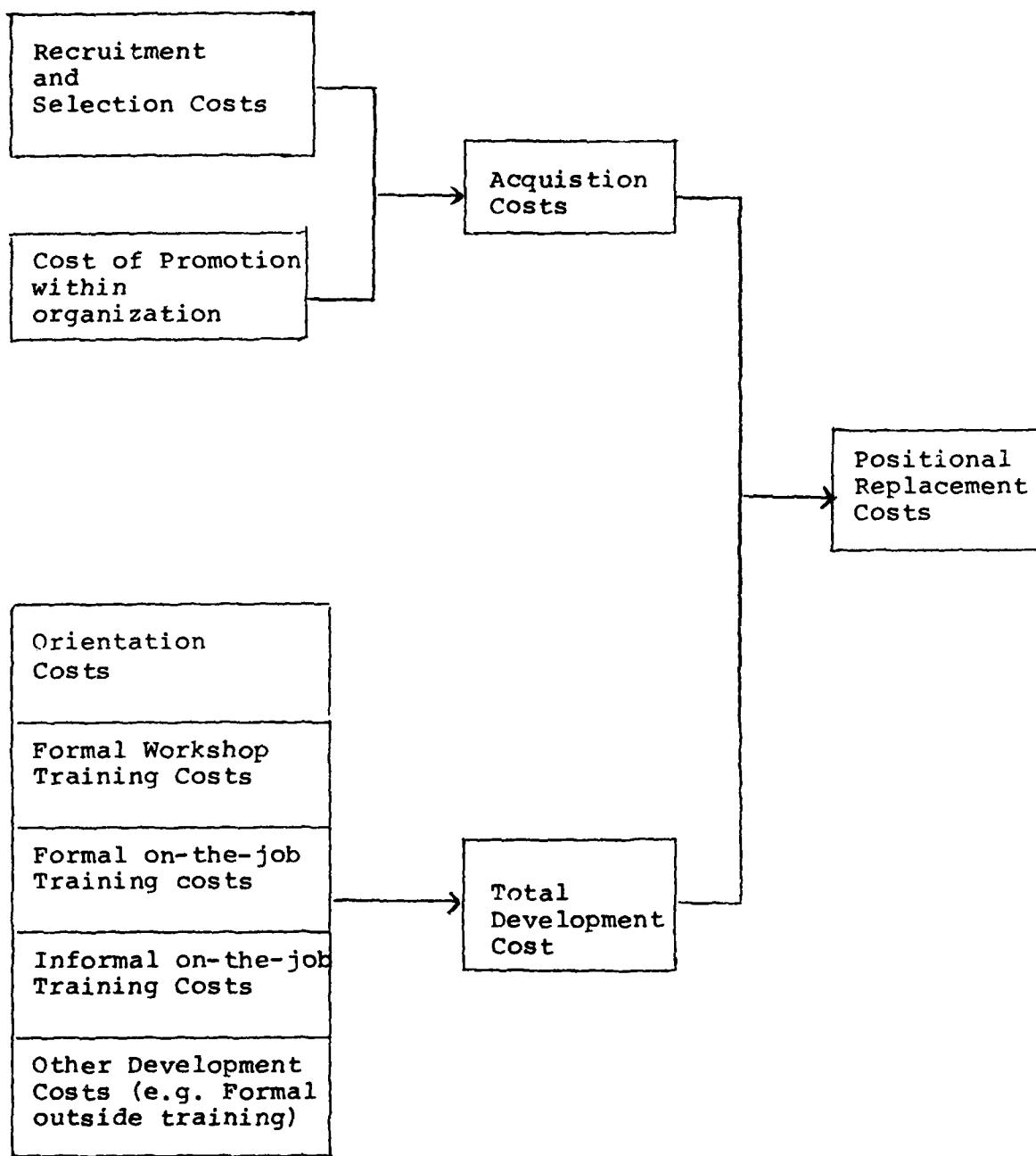
This third step involved interviewing the Branch Heads, designated employees of their branches, and representatives of the Personnel or Industrial Relations Departments in order to analyze the types of costs that are incurred as part of the recruitment selection and training process. Data sources detailing cost categories were also helpful in classifying labor, service and materials costs.

Development Models of Human Resource Replacement Cost

This step was based upon the analysis of the information obtained in the first three steps. It required the building of a human resource positional replacement cost model which adequately accommodated the recruitment, selection and training costs which were identified. This model also needed to be sensitive to the fact that the targeted position was not entry level and therefore appropriate costs along a career path needed to be accumulated.

Positional replacement cost is operationally defined as the cost to recruit, select and develop an individual in order to bring him/her up to a performance level typically expected in a given position. For purposes of this analysis, replacement cost can be regarded as being made up of two main components: acquisition costs and development costs. The model that was utilized in this study is shown in Figure 1 and is explained next:

FIGURE 1

Model for Calculations of
Positional Replacement Cost

Acquisition Costs

For the entry level position, acquisition costs consists of two major parts - recruitment and selection costs. In this present study, recruitment costs that were identified ranged from a requisition to hire from the Industrial Engineering Department to Personnel to the screening of applicants by a staffing specialist. Recruitment cost per hire can be calculated from the accumulation of this cost information.

Selection costs for the entry level position ranged from items such as the labor cost associated with candidate review by a branch head to preliminary orientation of the new hire. Calculation of selection cost per hire must be sensitive to hire cost per application as well as number of applications per hire.

The targeted position of GS-12 Supervisory Industrial Engineer is not an entry level position but instead reflects career progression along a distinctive career path. Hence in order to calculate the replacement costs of positions leading to the GS-12 position, it is necessary to accumulate the replacement costs of positions leading to the GS-12 position. In other words, the acquisition cost component of a GS-12 Supervisory Industrial Engineer is the positional replacement cost of a GS-11 Industrial Engineer, the position which under normal circumstances which will have to be refilled upon promotion to the GS-12 status.

Development Costs

Development costs comprise the other major element in calculating replacement cost. Development costs for each position along a career ladder are defined as those costs which are necessary to bring the employee up to the expected level of performance.

Five basic components were identified in the training and development costs associated with the career ladders leading to GS-12 Supervisory Industrial Engineer, although not all five components were found at each stage of the career ladders. The five components are: orientation costs, formal workshop training costs, formal OJT (On-the-Job Training) costs, informal OJT costs and other costs associated with outside education and training.

Orientation costs involved the costs incurred when the employee is exposed to his/her new work environment, including the discussion of the organizational policies, procedures and benefits.

Formal workshop training encompasses standard classroom type situations where the employee is given instruction relevant to his/her position.

Formal on-the-job training (OJT) occurs when the employee is working (usually under close supervision) and is undergoing simultaneous instruction by a supervisor.

Informal OJT is similiar to formal OJT, but is not accompanied with the same amount structure in task assignment.

Other development costs included such items as tuition and travel associated with classwork at outside colleges.

Design Data Collection and Implement

The next step involved collecting human resource replacement cost data on a pilot basis for the targeted position, GS-12 Supervisory Industrial Engineer. Utilizing the models developed in the previous step, interviews were conducted with appropriate personnel both at Seal Beach and at North Island. Relevant costs in all previously identified classifications of recruiting, selection and training necessary to bring an employee up to an acceptable level of performance were documented.

Appendix B (Exhibit 1-7) identifies the cost components present in recruitment, selection and training at Seal Beach and at North Island. In these Exhibits, the following terminology and conventions are used:

1. "Allocation Ratio" reflects the proportion of a given employee's time required by the task at hand. Hence an allocation ratio of 3/1 for a branch head in a selection interview reflects the necessity of 3 interviews before one hire is made. An allocation ratio of .166 = 1/6 for a trainer's time implies an average class of 16 trainers, so that 1/16 of the trainer's time is charged to each trainee.

2. All costs are rounded to the nearest dollars.
3. "% non-productive" is the percentage of time an employee is engaged in training activities. In the case of an employee being trained, "% non-productive" refers to the average short fall for the expected level of performance over the stated period of time.
4. A payroll benefits loading of 30% is included in labor costs.

Calculate Replacement Costs

Using the data collected according to the procedure discussed above, replacement cost for the position of GS-12 Supervisory Industrial Engineer was calculated.

Analyze Cost Data for Human Resource Management Implications

The final step involved analyzing the implications of the replacement cost data was analyzed. Questions such as how can management use this information in order to improve decision making in the area of human resource management were addressed. Issues requiring future research were also detailed.

FINDINGS

Calculation of Positional Replacement Costs

As previously discussed, the targeted position of GS-12 Supervisory Industrial Engineer is not entry level but reflects progression along a distinct career path. These career paths at Seal Beach and at North Island are shown in Figure 2 and Figure 3.

In order to calculate the replacement cost for the GS-12 at these two sites, it is necessary to accumulate the replacement costs of positions leading to the targeted position. (See the methodology section for further details).

Tables 2 and 3 provide a summary of the replacement cost calculation for GS-12 Supervisory Industrial Engineers at Seal Beach and at North Island, respectively. Tables 4 and 5 provide a comparison of these costs for GS-11 Industrial Engineers and for GS-12 Supervisory Industrial Engineers at Seal Beach and North Island. Exhibits 1-7 (Appendix B) provide detailed backup for these calculations.

Differential Career Paths and Replacement Costs

Examination of the career paths for GS-12 Supervisory Industrial Engineer at Seal Beach (Figure 2) and at North Island (Figure 3) reveals that there is not a standard career path to the targeted position.

TABLE 2

Summary of Replacement Cost Calculations
for GS-12 Supervisory Industrial Engineers

(Seal Beach)

	<u>Cost</u>	<u>Cumulative Total Investment</u>
A. Acquisition Costs	\$653	\$653
B. Development Costs *		
1. GS-11 Industrial Engineer	3,317	3,970
2. GS-12 Supervisory Industrial Engineer	<u>19,626</u>	<u>23,596</u>
3. Total Development Costs	<u>22,943</u>	
C. Total Replacement Cost	<u>23,596</u>	

* The cost of developing a GS-12 Supervisory Industrial Engineer includes the cost of developing a GS-11 Industrial Engineer plus the differential cost to make the developmental transition to performance at the GS-12 level. Thus costs incurred at the GS-11 level to develop a GS-12 engineer are \$3,317, and the costs at the GS-12 level are 19,626.

TABLE 3

Summary of Replacement Cost Calculations
for GS-12 Supervisory Industrial Engineers
(North Island)

	<u>Cost</u>	<u>Cumulative Total Investment</u>
A. Acquisition Costs	<u>\$870</u>	\$870
B. Development Costs *		
1. GS-5 Industrial Engineer Trainee	5,303	6,173
2. GS-7 Industrial Engineer	5,885	12,058
3. GS-9 Industrial Engineer	492	12,550
4. GS-11 Industrial Engineer	4,633	17,183
5. GS-12 Supervisory Industrial Engineer	<u>11,852</u>	<u>\$29,035</u>
6. Total Development Cost	<u>28,165</u>	
C. Total Replacement Cost	<u>29,035</u>	

* Cost to develop a GS-12 Supervisory Industrial Engineer includes the cost of development incurred at lower levels.

TABLE 4
Comparison of Recuriting and Selection
Costs at Seal Beach and North Island

	<u>Seal Beach</u>	<u>North Island</u>
Recruitment & Selection		
Labor Costs		
Requisition	1	8
Personnel Dept.	137	52
Selection	310	148
Personnel Dept.-Processing	14	76
Orientation	<u>6</u>	<u>60</u>
	468	344
Benefits (30%)	<u>141</u>	<u>103</u>
	609	447
Other Costs		
Computer Services	5	0
Printed Materials	39	0
Travel & Per diem	<u>0</u>	<u>423</u>
TOTAL RECRUITMENT & SELECTION COSTS	654	870

(Note: Costs are rounded to whole numbers for presentation. Hence small differences, due to rounding with Appendix B, Exhibits 1-7 may exist.)

TABLE 5

Comparison of Training Costs at Seal Beach
and North Island for GS-11 Industrial Engineers
and GS-12 Supervisory Industrial Engineers

	<u>GS-11</u>		<u>GS-12</u>	
	<u>SB</u>	<u>NI</u>	<u>SB</u>	<u>NI</u>
<u>Labor</u>				
Formal Workshop Training	99	1,495	1,793	2,118
Informal OJT Training	<u>2,452</u>	<u>0</u>	<u>11,304</u>	<u>6,799</u>
	2,551	1,495	13,097	8,917
Benefits	<u>766</u>	<u>449</u>	<u>3,929</u>	<u>2,675</u>
	3,317	1,944	17,026	11,592
<u>Other Costs</u>				
Tuition	0	800	500	260
Travel & Per diem	<u>0</u>	<u>1,890</u>	<u>2,100</u>	<u>0</u>
	3,317	4,634	19,626	11,852

TABLE 6

Comparison of Replacement Costs
for GS-11 Industrial Engineers
at Seal Beach and North Island

	<u>Seal Beach</u>	<u>%</u>	<u>North Island</u>	<u>%</u>
Acquisition Costs	653	16%	870	5%
Development Costs	3,317	84%	16,313	95%
Total	3,970	100%	17,183	100%

TABLE 7

Comparison of Replacement Costs
for GS-12 Supervisory Industrial Engineers
at Seal Beach and North Island

	<u>Seal Beach</u>	<u>%</u>	<u>North Island</u>	<u>%</u>
Acquisition Costs	653	3%	870	3%
Development Costs	22,943	97%	28,165	97%
Total	23,596	100%	29,035	100%

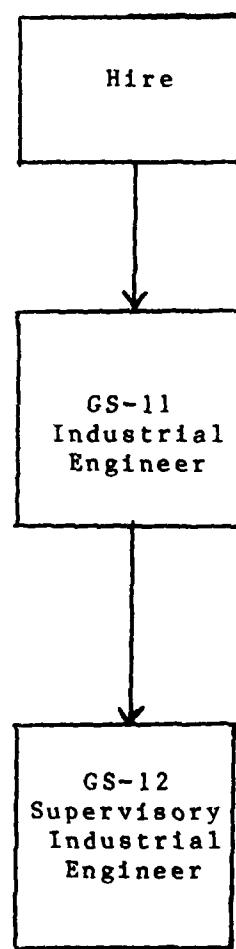
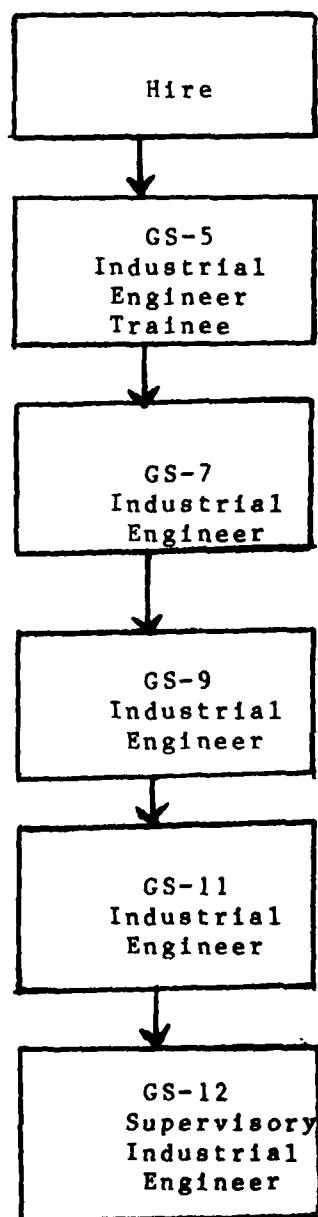
FIGURE 2**CAREER PATH LEADING TO GS-12 SUPERVISORY INDUSTRIAL ENGINEER
(Seal Beach)**

FIGURE 3**CAREER PATH LEADING TO GS-12 SUPERVISORY INDUSTRIAL ENGINEER
(North Island)**

Seal Beach typically hires at the more experienced GS-11 Industrial Engineer level, while North Island hires at the less experienced GS-5 Industrial Engineer Trainee level and has a multiple step career ladder for the GS-5 to reach GS-11 Industrial Engineer or GS-12 Supervisory Industrial Engineer.

This difference in career path is an obvious factor to consider in discussing any variance which exist in positional replacement costs at the two sites. Table 2 shows that the replacement cost for the GS-12 Supervisory Industrial Engineer at Seal Beach is \$23,596, while Table 3 shows the corresponding cost of North Island to be \$29,035. Hence North Island with its longer career path to GS-12 Supervisory Industrial Engineer, as expected, has the higher replacement cost for this position.

Table 4, 5, 6 and 7 provide specific comparison data for the two sites. In particularly, Table 6 provides comparative data for the GS-11 Industrial Engineer position at the two sites. The replacement cost for this position at Seal Beach is \$3,970, while the corresponding cost at North Island is \$17,183.

Of course one cannot draw firm conclusions from the magnitude of this replacement cost data without analysis of the non-quantitative factors which impact human resource decision making at the two sites. Some of these factors are considered below.

Qualitative Observations: Career Paths

In making qualitative observations relating to the career paths and corresponding replacement costs data at Seal Beach and North Island, our intent is to be descriptive rather than evaluative of the management practices at the two research sites. The sole purpose of these observations is to suggest how this data might be used to identify issues relevant to human resource management.

There appears to be a number of factors which account for differences in career paths leading to GS-12 Supervisory Industrial Engineer at Seal Beach and at North Island. The following three factors seem to be prominent:

1. Labor market conditions -- Seal Beach's management reports that it has not been possible to recruit GS-5's or GS-7's because the government salary schedule is not competitive with corresponding entry-level jobs in the commercial sector. However, Seal Beach has been able to recruit industrial engineers at the GS-11 level. In addition Seal Beach has been able to recruit a number of GS-12's who have accepted a downgrade to the GS-11 Industrial Engineer position. On the other hand, North Island has had some success in recruiting GS-5's or GS-7's and consequently operates with this as the entry-level position.

2. Environmental factors -- As mentioned above Seal Beach has successfully recruited GS-12's who were willing to take a downgrade to GS-11. Their willingness to do so reflects underlying factors such as each of commute to Seal Beach and overall work atmosphere at the Seal Beach location.

3. Strategy -- North Island's strategy for human resource development for industrial engineers reflects a career path whereby an employee normally spends approximately one year at each of the following positions: GS-5, GS-7, GS-9 and GS-11. This reflects an internal development strategy. Seal Beach's strategy as referred to in large part may result from the previously mentioned labor market and environmental conditions. However, it may be that independent of these two factors Seal Beach is deciding to hire more experienced personnel, thus reducing training costs. This strategy could have particular appeal if one assumed turnover to be inevitable, as "lost" training costs would be minimized.

Intersite Differences in Recruiting, Selection and Training Costs

The differences in recruiting and selection costs between the two sites is a result of the environmental and labor market factors outlined in the "Qualitative Observations" section. The North Island site hires primarily recent college graduates which necessitates incurring additional travel costs for out-of-state candidates. The Seal Beach site hires primarily local applicants.

The significant differences in training costs between the two sites is a result of the same factors. Seal Beach hires at the GS-11 and GS-12 levels, while the North Island site is able to recruit GS-5 and GS-7 level engineers. The training and development costs involved in the engineer's progression for GS-5/7 to GS-12 is a cost born by the Navy in the case of North Island. These costs are absent from the cost structure at Seal Beach, as more experienced engineers are hired who have been trained at another organization's expense.

Interstep Differences in Training Costs

As an engineer progresses through the successive grade levels, there is an uneven progression with respect to technical skills requirements at each level. Thus there is a corresponding fluctuation in training requirements and the associated costs. This occurs, for example, in the training costs at the GS-9 level at the North Island

site. At this grade level, only a technical writing skills course is attended, as opposed to the several technical engineering courses at the GS-7 and GS-11 levels.

USES AND IMPLICATIONS OF REPLACEMENT COST INFORMATION

Table 8 provides a summary of the general uses of replacement cost information in human resource management decision making areas.

Uses of replacement cost information in Naval Operations will be discussed at two levels of human resource management, the operational and the strategic. Two specific areas of use will be discussed for each level.

Operational Level

1. "Make or Buy decision: This study provides replacement cost information which facilitates acquisition-development trade-off decisions. In particular is it more cost effective to recruit relatively inexperienced people and train them internally or buy more experienced people?

Table 6 and 7 provide this information for the GS-11 Industrial Engineer and for the GS-12 Supervisory Industrial Engineer. For the GS-11, the buying of outside people (if this option is available) significantly reduces training costs. (It must be pointed out we are com-

TABLE 8

Uses of Replacement Cost Information in Human Resource ManagementDecision Making

<u>Human Resource Management Functions</u>	<u>Use of Replacement Cost Information</u>
Acquisition	1. Provide cost information to budget acquisition: historical and standard costs.
Development	1. Provides information about cost of development programs for budgetary planning and facilitates acquisition-development trade-off decisions.
Allocation	1. Provides information about resource costs for investment and allocation decisions.
Conservation	1. Provides cost turnover for use in turnover control programs.
Evaluation and Reward	1. Provides measures to permit analysis of compensation in relation to replacement cost.

paring data across sites so some restraint must be exercised in unequivocally asserting this conclusion). However for the GS-12, the cost spread shrinks, evidently due to more extensive training necessary to train a supervisor who has not come up through the ranks internally.

2. "Reenlistment Reward" decisions: Knowing replacement costs information can aid in the analyzing whether a "reenlistment bonus" is cost effective to the Navy. For example, suppose GS-12 Supervisory Industrial Engineer has an associated \$29,000 replacement cost, and other considerations argue for retention of this person. Retention of this employee because of an offer of a three year \$2900/year "reenlistment bonus" would achieve a savings of the \$29,000 replacement cost for the three year period at a marginal cost of \$2,900/year, a "cost of human capital" of 10% for this three year period. Given the financial environment at the time of this writing this would most likely represent a judicious decision.

Note: The above method of analysis is making simplifying assumptions. A more sophisticated analysis should include discounting all cash savings and outflows to reflect the present value of money, including the eventual replacement cost expense when turnover does occur. The above "cost of human capital" is intended only to be representative of a genre of decisions that can be made using replacement cost information.

Strategic Level

Uses of replacement cost information at the strategic level of human resource decision making is at the cutting edge of future research in

the area of human resource management. The two areas discussed below are only suggestive of the types of analyses possible.

1. "Optimal Manpower Mix" decisions: Replacement Cost information can provide management with standard replacement costs relating to various personnel classifications. Such information is central for management to use in addressing the following questions in a cost effective manner. Given the mission of our department, what types of people should we hire and in what mix?

For example, at Seal Beach, management in the Industrial Engineering division must decide on an optimal mix of industrial engineers and industrial engineer technicians (non-degreed). Cost effective analysis can only be done if the "lingua franca" of replacement cost data is included in the analysis.

2. Forecasts of Manpower Inventory: Selection and development policy relating to personnel is obviously central to the future pool of both technical and managerial manpower in the Navy. However, the specific linkages between future manpower and corresponding costs under alternative selection, development and reward scenarios is far from obvious. Human resource replacement costs (stochastically derived) are a vital element in costing out alternative manpower forecasts. A thorough discussion of this issue is beyond the scope of this report. This area is only included in order to appreciate the range of applicability of replacement cost information.

CONCLUSION

This research has developed and applied a model for measuring human resource replacement cost of Industrial Engineers at two sites, the Seal Beach Naval Weapons Station and the North Island Naval Air Rework Facility.

Some uses and implications of replacement cost information for operational and strategic human resource decision making were described. The widespread utility of replacement cost information in linking human resource decision making with the "coin of the realm" was demonstrated.

Further research in the use of positional replacement cost data in human resource management is needed. There are three major areas particularly important to be addressed in further study:

1. Computer-based operationalization of replacement cost information:

To be used effectively, replacement cost data for targeted positions must be readily available and current. Computer systems must replace manual data collection procedures for this to occur.

2. Analysis of behavioral implications of using replacement cost information:

This analysis should study changes in the attitude and/or behavior of managers when presented with replacement cost information relating to their employees. This involves "impact evaluation" of replacement cost information on management processes.

3. Utilization analysis of replacement cost information in human resource decision making:

As discussed in the USES AND IMPLICATIONS section of this report, replacement cost data "monetizes" information necessary for cost effective human resource operational and strategic decisions. Further research in using this information operational policies relating to acquisition, development, allocation, conservation and evaluation and reward of human resources needs to be conducted. The uses of human resources replacement cost information in manpower planning and forecasting is a particularly important area for further research.

APPENDIX A

JOB DESCRIPTIONS OF POSITIONS LEADING TO GS-12

SUPERVISORY INDUSTRIAL ENGINEERS

AT

SEAL BEACH

AND

NORTH ISLAND

SEAL BEACH LOCATION**Job Description
Supervisory Industrial Engineer (GS-12)**

The following tasks and responsibilities are common to all three Supervisory Industrial Engineer positions. These characteristics are related to the task of supervision rather than the specific subject area.

Has supervisory and administrative direction, technical control, and decision authority for operation of that branch. Responsible for establishing objectives, programs, plans, and policies for the branch's various responsibilities. Makes assignments and establishes work priorities and schedules for the projects assigned to the branch. Performs accuracy reviews for any part of a project or assignment that is considered critical as related to safety or the obligation of larger amounts of funds. Evaluates the work of subordinates. Hears and resolves employee complaints and effects minor disciplinary actions. Responsible for safety of personnel within the unit. Responsible for carrying out line responsibilities of the EEO programs.

Each individual supervisory position can then be described in terms of tasks and responsibilities specific to that branch's operations.

Methods Engineering - Supervisory Industrial Engineer

Assists station elements to work smarter rather than harder. Directs the development for evaluation and analysis of existing work methods. Directs work systems effectiveness studies. Effects matrix management for increased functional organization availability to assist other departments when tasks become extremely complex. Participates in the investigation of explosive incidents and prepares engineering recommendations to preclude their future occurrence.

Equipment Engineering - Supervisory Industrial Engineer

The Head of the Equipment Engineering Branch is responsible for the development, design, specification, and validation of the need and benefits of equipment and industrial processes. These general objectives are accomplished through the supervision of GS-11 engineers and engineering techniques in the following tasks: Develops, designs, specifies, and adapts modifications to industrial equipment to specific production needs and to comply with safety, health, and environmental requirements. Develops and monitors the yearly equipment installation plan and budget. Manages the Radio Communication Program. Provides technical guidance and review on all office copy equipment requests. Provides technical advice and authority for various internal programs.

Facility Engineering - Supervisory Industrial Engineer

Through supervision of industrial engineer and industrial engineering technicians, accomplishes the following:

Plans for modifications and new layout in existing facilities. Plans and develops new facilities and their economic justifications. Performs space assignment studies and makes recommendations for assignments. Determines siting for new facilities or relocated facilities. Maintains computerized space assignment system and building drawings. Performs special studies on non-Navy proposals that could affect station facilities. Reviews all building demolition requests and suggestions.

Job Description**Journeyman Industrial Engineer (GS-11)****Equipment Engineering Branch**

Develops processes and/or equipment systems that replace and modernize manual functions. Develops and designs non-commercially available ordnance handling equipment and designs modifications to existing equipment. Develops, designs, and specifies non-commercially available special tools and equipment. Provides field engineering service for equipment problems and develops a plan of corrective ac-

tion. Reviews contractor equipment fabrication drawings to ensure adherence to procurement specifications. Plans for equipment changes. Develops data to evaluate existing equipment against present requirements. Determines what additional equipment or replacement is needed to satisfy organization or workload changes. Develops total equipment plan to reflect all recommendations. Conceives and develops annual equipment installation plan and budget requirements through statistical forecasting. Provides engineering guidance to technicians and lower level engineers as required. Serves as technical authority for "fast payback equipment program." Conducts payback past analysis on any equipment items which did not recover investment costs within defined limits. Develops annual "fast payback budget plan".

Facility Engineering Branch

Plans for facility changes within existing buildings. Develops, analyzes, and interprets data. Reviews and validates construction drawings as to whether the drawings meet facility requirements. Plans for new construction projects for facilities for the purpose of replacing or expanding input for future workload estimating and bidding proposals. Provides engineering guidance to technicians and lower level engineers as required. Performs special studies on proposal made by non-station organizations that could have an adverse impact on property or facilities.

Methods Engineering Branch

Performs Product/item work cycle studies which evaluate the entire sequence of events that affect the product/item from the time it arrives on the station to the time that it leaves. Analyzes work elements to determine if mechanization or automation could be cost effective. Performs work systems effectiveness studies using various industrial engineering techniques. Makes final recommendation and conceives a management action plan to implement recommendations and provides follow-up audits on implemented recommendations. Conducts process analysis of existing work cycles for the purpose of integrating new or proposed work into the existing work. Participates in workload and planning meeting where future work projects are being proposed and developed. Provides industrial engineering advice for the integration planning of new work. Conducts special one-time studies.

NORTH ISLAND LOCATION**Job Description****Supervisory Industrial Engineer (GS-12)**

Provides multi-discipline engineering service as pertains to all aspects of the utilization of covered building space and real property assets. Prepares detailed engineering studies to enhance productivity by modifications to existing internal and external shop arrangements based on workflow, present manufacturing technology, and product mix. Serves in advisory capacity to production departments in eliminating specific critical production problem areas and remains constantly knowledgeable of the workload assignments and trends in the area. Provides detailed planning of the maintenance of the buildings and installed equipment in his area of cognizance. Responsible for planning recurring maintenance programs. Specific maintenance projects, and major repairs projects. Monitors the proper performance of the maintenance action. Plans and prepare all necessary supportive justification and funding documents for plant improvement projects. Must analyze project, classify the work type, seek funding and implementation. Reviews all phases of projects design documents. Provides constant inspection of project area during construction. Responsible for assuring that all areas are designed and constructed in configuration which complies with existing safety, health, energy, and environmental regulations and standards. Makes continuous inspections to determine deficiencies with respect to these. Provides special industrial engineering studies for management when required. Plans and assigns work to section personnel. Directs and reviews work of subordinate employees. Supervises indus-

trial engineers and industrial engineering technicians. Exercises all personnel administration responsibilities.

Makes continuous inspections to determine deficiencies with respect to these. Provides special industrial engineering studies for management when required. Plans and assigns work to section personnel. Directs and reviews work of subordinate employees. Supervises industrial engineers and industrial engineering technicians. Exercises all personnel administration responsibilities.

Industrial Engineer (GS-9)

Provides professional industrial engineering services to aid in the planning, development, design, and implementation of plant facility projects for the repair, alteration, and peculiar maintenance of existing facilities, equipment installations, minor construction, pollution abatement, and energy conservation. Conducts industrial engineering surveys to gather data on each project for review of the facility manager. Develops layouts, sketches, and diagrams for shop and equipment installation and relocation within existing or proposed facilities. Participates in the review of detailed project plans, cost estimates, and specifications prepared by commercial architects and engineers. Assistant in conducting special industrial engineering studies for management when required.

Industrial Engineer (GS-7)

Conducts industrial engineering studies to determine the nature and requirements of operations. Determines current and projected work-

load, processing time, work flow, manpower requirements, and equipment availability. Analyzes data to establish an efficient layout, and to identify handling and storage problems and environmental and utility requirements. Employs techniques of statistical analysis, linear programming, and engineering economics to develop the analysis of the survey. Determines need for new or improved facilities and develops specific projects to provide for these. This includes the preparation of plans and specifications for accomplishing all of the tasks involved. Prepares information for approval and funding of larger projects. Monitors local and/or contractual architect and engineering services required to convert plans and requirements to drawings and specifications. Coordinates the accomplishment phase of the project.

Industrial Engineer (GS-5)

This is a basic trainee position in the Engineer Intern Program. The incumbent receives professional development for higher level engineering work.

Conducts industrial engineering studies to provide basic data for the planning and design of command facilities. Assists higher level engineers in the planning and design of these facilities. Assists in the design and development of projects for the treatment and control of industrial wastes and for the abatement of noise, traffic control and parking facilities, and communications systems. Prepares engineering drawings and specifications. Assists in preparation and approval of funding documents and related correspondence.

Position requires a BSIE or equivalent.

APPENDIX B

CALCULATION OF REPLACEMENT COST

EXHIBITS 1-7

Exhibit 1

**Human Resource Cost of Recruitment and Selection
(Seal Beach)**

COMPONENTS	WHO?	(1) SALARY RATE	(2) HOW MUCH TIME? (HOURS)	(3) * (2)	(4) ALLO-CATION RATIO	(3) * (4) COST (\$)	(5)
LABOR COSTS:							
1. Requisition							
		GS-5 Clerk	6.80	.1	.68	2	1
2. Personnel (Distribution of announcement) (Screening, rating, etc.) (Print shop)							
	GS-5 Typist	6.80		2	13.60	2	27
	GS-11 Staffing Spec.	12.46		4	49.84	2	100
	WP-10	9.68		.5	4.84	2	10
3. Selection (Candidate review) (Justification) (Interviews)							
	GS-12 Branch Head	14.94		.8	11.95	3	36
	GS-12 Branch Head	14.94		.25	3.74	3	11
	GS-12 Branch Head	14.94		3.5	52.29	3	157
	GS-13 Dep't Head	17.76		2	35.52	3	107
4. Personnel (Processing)							
	Clerk	5.52		2.5	13.80	1	14
5. Orientation							
	COST SUBTOTAL--LABOR						
TOTAL LABOR COST = COST SUBTOTAL * (1+BENEFITS LOADING=1.3)							
OTHER COSTS							
	Computer services					5	
	Printed Materials					39	
						653	
TOTAL RECRUITMENT AND SELECTION COSTS							
						609	

Exhibit 2

**Human Resource Cost of Training
GS-11 (Industrial Engineer)
(Seal Beach)**

COMPONENTS	WHO?	(1) SALARY RATE	(2) HOW MUCH TIME? (HOURS)	(3) (1) * (2)	(4) ALLO-CATION	(5) (3) * (4)	(6) % NON-PRODUC-TIVE	(7) COST (\$)
<hr/>								
FORMAL WORK-SHOP TRAINING							NOTE 3	
	GS-11 IE	12.46	7	87	1	87	100	87
	GS-11/12 Trainer	13.45	14	188	.07	12	100	12
INFORMAL OUT TRAINING	GS-11 IE	12.46	480	5981	1	5981	25	1495
	GS-12 Branch Head	14.94	480	7171	1	7171	5	359
	GS-11 IE (peer)	12.46	480	5981	1	5981	10	598
<hr/>								
TRAINING COST SUBTOTAL								
TOTAL TRAINING COST = COST SUBTOTAL * (1+BENEFITS LOADING=1.3)								
2551								
3317								

Exhibit 3

**Human Resource Cost of Training
GS-12 (Supervisory Industrial Engineer)
(Seal Beach)**

COMPONENTS	WHO?	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FORMAL WORK-SHOP TRAINING		SALARY RATE	HOW MUCH TIME? (HOURS)	(1) * (2)	ALLO-CATION	(3) * (4)	NON-PRODUCTIVE TIME	(5)* (6) COST (\$)
ON-THE-JOB TRAINING	GS-12 Supervis. IE GS-13 Dep't. Head	14.94 17.76	120 2000	1793	1	1793	100	1793
TRAINING COST--LABOR SUBTOTAL		2000 35520	29880 1	29880 35520	1	29880 35520	20 15	5976 5328
TOTAL TRAINING COST (LABOR) = LABOR SUBTOTAL * (1+BENEFITS LOADING=1.3)					13097	17026		
OTHER TRAINING COSTS							500 2100	-----
TUITION TRAVEL								
TOTAL TRAINING COSTS						19626		

Exhibit 4

**Human Resource Cost of Recruitment and Selection
(North Island)**

COMPONENTS ----- LABOR COSTS:	WHO? -----	(1)	(2)	(3)	(4)	(5)
		SALARY RATE -----	HOW MUCH (HOURS)	(1)* (2)	ALLO-CATION RATIO -----	(3)* (4) COST (\$)
1. Requisition (IE to IRD)	GS-5 Clerk GS-14 Div. Director GS-15 Dept. Head GS-11 Position Mgr. O-5 Exec. Officer	6.80 20.99 24.69 12.46 19.32	.2 .1 .1 .1 .1	1.36 2.10 2.47 1.25 1.93	1 1 1 1 1	1 2 2 1 2
2. Wage & Classif. (IRD to Placement Office)	GS-11 Staffing Spec. GS-5 Clerk GS-11 Staffing Spec.	12.46 6.80 12.46	.1 .1 .4	1.25 .68 49.84	1 1 1	1 1 50
3. Selection (Phone calls) (Interviews)	GS-11 GS-12 Section Head GS-12 Branch Head GS-14 Div. Director	12.46 14.94 14.94 20.99	.25 2 .25 .25	3.12 29.88 3.74 5.25	10 3 3 3	31 90 11 16
4. Hiring (Physical Exam) (Security Review) (Pre-processing)	GS-5 Clerk GS-13 Medical Off. GS-11 Security Off. GS-5 Clerk	6.80 17.76 12.46 6.80	.1 .75 4 1.75	.68 13.32 49.84 11.90	1 1 1 1	1 13 50 12
5. Gen. Orientation	GS-12 Section Head	14.94	4	59.76	1	60
COST SUBTOTAL					344	
TOTAL LABOR COST = COST SUBTOTAL * (1+BENEFITS LOADING=1.3)					447	
OTHER COSTS	Travel for interviewees (3 interviewees per selection) Per diem for interviewees (3 interviewees per selection)				198 225	
TOTAL RECRUITMENT AND SELECTION COSTS					870	

Exhibit 5

**Human Resource Cost of Training
GS-5 (Industrial Engineer Trainee)
(North Island)**

COMPONENTS	WHO?	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		SALARY RATE	HOW MUCH TIME? (HOURS)	(1) * (2)	ALLOCATION RATIO	(3) * (4)	% NON-PRODUCTIVE	(5) * (6) CCST (\$)
ORIENTATION	GS-12 Supervisor. IE GS-5 Trainee	14.94 6.80	4 4	60 27	1 1	60 27	100 100	60 27
FORMAL WORK-SHOP TRAINING	GS-12 ME GS-5 Trainee	14.94 6.80	44 22	657 150	.066 1	43 150	100 100	43 150
FORMAL OJT	GS-11/12 IE GS-5 Trainee	13.45 6.80	160 160	2152 1088	.166 1	357 1088	40 20	143 218
INFORMAL OJT	GS-11/12 IE GS-5 Trainee	13.45 6.80	800 800	10760 5440	.166 1	1786 5440	25 55	447 2992

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TRAINING COST SUBTOTAL
TOTAL TRAINING COST = COST SUBTOTAL * (1+BENEFITS LOADING=1.3)
5303

4079

Exhibit 6

Human Resource Cost of Training
GS-7, 9, 11 (Industrial Engineer)
(North Island)

COMPONENTS	WHO?	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		SALARY RATE	HOW MUCH TIME? (HOURS)	(1) * (2)	ALLO- CATION RATIO	(3) * (4)	* NON- PRODUC- TIVE COST	

FORMAL WORK--
SHOP TRAINING

GS-7 IE	8.68
GS-9 IE	9.99
GS-11 IE	12.46

GS-7 IE	120
GS-9 IE	24
GS-11 IE	120

TRAINING COSTS--LABOR SUBTOTAL

TOTAL TRAINING COSTS LABOR = LABOR SUBTOTAL * (1+BENEFITS LOADING=1.3)

Other Training Costs

GS-7: Tuition 1600
Travel 1190
Per Diem 1740

GS-9: Tuition 180
Travel 0
Per Diem 0

GS-11: Tuition 800
Travel 540
Per Diem 1350

TOTAL TRAINING COSTS

11010

Exhibit 7

**Human Resource Cost of Training
GS-12 (Supervisory Industrial Engineer)
(North Island)**

COMPONENTS	WHO?	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		SALARY RATE	HOW MUCH TIME? (HOURS)	(1) * (2)	ALLO-CATION	(3) * (4)	% NON-PRODUC-TIVE	(5) * (6) COST (\$)
-----	-----	-----	-----	-----	-----	-----	-----	-----

**FORMAL WORK-
SHOP TRAINING**

GS-12 Supervis. IE	14.94	136	2032	.1	2032	100	2032
GS-11/12 Trainer	13.45	160	2152	.04	86	100	86

**ON-THE-JOB
TRAINING**

GS-13 Branch Head	17.76	800	14208	1	14208	10	1421
GS-12 Supervis. IE	14.94	800	11952	1	11952	45	5378

TRAINING COST--LABOR SUBTOTAL

TOTAL LABOR COST = LABOR SUBTOTAL * (1+BENEFITS LOADING=1.3)

OTHER TRAINING COSTS

Tuition	260
Travel	0
Per Diem	0

TOTAL TRAINING COSTS

11852

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